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United States Patent [19]**Nedderman, Jr.**[11] **Patent Number:** **5,708,232**[45] **Date of Patent:** **Jan. 13, 1998**[54] **HIGHLY MANEUVERABLE UNDERWATER VEHICLE**4,579,298 4/1986 Thomson 244/3.21
5,139,216 8/1992 Larkin 244/3.21[75] **Inventor:** **William H. Nedderman, Jr.**
Middletown, R.I.**Primary Examiner**—Michael J. Carone
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Attorney, Agent, or Firm—Michael J. McGowan; Robert W. Gauthier; Prithvi C. Lal[73] **Assignee:** **The United States of America as represented by the Secretary of the Navy, Washington, D.C.**[57] **ABSTRACT**[21] **Appl. No.:** **730,919**[22] **Filed:** **Oct. 10, 1996**[51] **Int. Cl.⁶** **F42B 10/00**[52] **U.S. Cl.** **114/23; 114/20.1; 244/3.1; 244/3.21; 244/3.23**[58] **Field of Search** **114/20.1, 22, 23, 114/312, 330, 331, 341; 102/384; 244/3.1, 3.21, 3.23**[56] **References Cited****U.S. PATENT DOCUMENTS**2,594,766 4/1952 Goddard 244/3.1 X
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A system of articulation units is inserted between sections of a standard cylindrical underwater vehicle, such as a torpedo, to provide a highly maneuverable vehicle. Each articulation unit consists of two bulkheads connected by a spherical joint which allows rotation about the joint. The bulkheads are connected to adjacent torpedo sections by means of standard joint bands. A number of hydraulic actuators are spaced radially about the spherical joint between the bulkheads. By selectively activating the actuators, the joint bends the vehicle about its longitudinal axis. The pressure of the surrounding medium against the moving vehicle causes the vehicle to turn in the direction of the bend. Depending on the actuators activated, the vehicle can be made to bend, or turn, in any direction, making for a highly maneuverable vehicle. The articulation units have flexible cover membranes over the space between the bulkheads so as to present a smooth surface to the surrounding medium and hence not appreciably increase the drag on the torpedo.

10 Claims, 4 Drawing Sheets